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Money demand stability: A case study of Nigeria

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Abstract

Monetary policy in Nigeria aims is to achieve price and monetary stability. During the 1980s and 1990s, monetary targeting was the dominant monetary policy framework in Nigeria. However, in 2006 the Central Bank of Nigeria (CBN) adopted the new monetary policy framework through which short-term interest rates are adjusted to achieve stability in the value of the domestic currency. This paper has presented an empirical investigation into the demand for Nigerian real narrow money (*M1*) over the period 1960–2008 in an attempt to identify whether the CBN were right to adopt the new monetary policy framework. In doing so, we estimate alternative (canonical and extended) specifications of *M1* demand using structural change methods. Our results suggest that the canonical specification is well-determined. Although the money demand relationship went through a regime shift in 1986, it is largely stable. These findings favour the use of supply of money as an instrument of monetary policy, thus lending limited support for the new monetary policy framework.

JEL classification: E21; C22

Keywords: Money demand; Structural breaks; Cointegration; Monetary policy

1. Introduction

The level and stability of the demand for money has received enormous academic attention because an understanding of its causes and consequences can usefully inform the setting of monetary policy. It is vital to investigate and test the stability of money demand since its instability

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is a major determinant of liquidity preference. In a seminal paper, Poole (1970) argued that the rate of interest should be targeted if liquidity preference is unstable while the money supply should be targeted if the investment-savings relationship is unstable and the demand for money is stable. It is necessary to select the correct monetary policy instrument since selecting the wrong instrument may result in large fluctuations in output.

The implementation of financial reforms in many countries has raised doubts about the use of monetary aggregates to stabilize inflation rates. Since the 1980s and following countless deregulation and liberalization policies, central banks in many advanced economies switched between instruments of monetary policy by moving away from policies that influence the money supply towards those which influence the bank rate. A large number of developed country case studies show that the demand for money has become unstable due to financial reforms and hence support the targeting of the rate of interest by central banks (see, for instance, Caporale & Gil-Alana, 2005; Haug, 1999, 2006; Maki & Kitasaka, 2006; McPhail, 1991).

Central banks in many developing economies have followed suit and switched towards monetary policies directed at the bank rate. A major part of this policy switching is grounded on the view that their own financial market reforms and liberalizations might have contributed to the instability in their own money demand functions. However, recent studies have raised doubts about the validity and strength of central bank interest rate targeting in developing economies (Bahmani-Oskooee & Rehman, 2005; Rao & Kumar, 2009a, 2009b; Rao, Tamazian, & Singh, 2009).

Our case study focuses on the Nigerian economy, which arguably squandered her benefits from the oil boom of the 1970s and suffered various political coups in the 1980s, including one in 1985 that led to a bout of political and economic policies that were designed to stabilize the economy. Most notably, Nigeria instituted the IMF's Structural Adjustment Program in 1986 with an aim of putting the economy on the path towards a drastic reduction in international dept; alas this program was abandoned in 1988. Such economic and political structural changes are likely to have significant influence on a range of economic relationships.

The key objective of monetary policy in Nigeria is to achieve price and monetary stability. Prior to liberalization in 1986, the major instruments of monetary policy were credit ceilings, cash reserve requirements and special deposits. The use of market-based instruments was not feasible at that point because of the underdeveloped nature of their financial markets and the deliberate restraint on interest rates. Open market operations continued to play a significant role in the post-1986 period. During 2002–2006 period, a 2-year rather than 1-year target was put in place. However, the Central Bank of Nigeria (CBN) introduced a new monetary policy framework in 2006 that aimed to achieve a stable value of the domestic currency through stability in short-term interest rates.[1] Other policies used recently include recapitalization and consolidation of banks. The CBN dealt with post-banking consolidation in 2006–2008 period. This resulted in gradual run-down of treasury bills and frequent adjustments in the bank rate.

The majority of studies that focus on the demand for narrow money in Nigeria have applied standard cointegration techniques. To the knowledge of the authors, there is currently no study that tests for structural changes in the narrow money demand relationship for Nigeria.[2] To fill this gap in the literature, the purpose of this paper is to contribute to the literature on the stability of money demand by investigating money demand relationships using more up-to-date econometric

[1] The bank rate is determined and operated by the CBN.

[2] Chukwu et al. (2010) did utilise structural change tests but for broader measures of money.

techniques that allow for structural breaks in the cointegrating relationship for Nigeria. In addition to estimating the canonical specification, alternative specifications are estimated which include additional variables to proxy for the cost of holding money. Utilising the insights from Poole (1970), we assess the validity of interest rate policy for Nigeria. We attempt to answer the important question: Should Nigeria use the rate of interest as the primary instrument of monetary policy? In doing so, we present the estimates and stability of narrow money demand.

This paper has the following structure. The next section provides a brief review of the empirical literature that focuses on money demand in African countries. Section 3 gives details of data, specification and method. The empirical results are presented and discussed in Section 4. Section 5 offers conclusions.

2. Money demand

Keynes (1936) developed the liquidity preference theory which explicitly highlights the transaction, precautionary and speculative motives for holding money. Laidler (1977) points out that Keynes did not regard the demand for money arising from the transactions and precautionary motives as technically fixed in their relationships with the level of income and therefore emphasized that the most important innovation in Keynes' analysis is his speculative demand for money. The primary result of the Keynesian speculative theory is that there is a negative relationship between money demand and the rate of interest.

Friedman (1956) opposed the Keynesian view that money does not matter and presented the quantity theory as a theory of money demand.[3] He modelled money as abstract purchasing power (meaning that people hold it with the intention of using it for upcoming purchases of goods and services) integrated in an asset and transactions theory of money demand set within the context of neoclassical consumer and producer behaviour microeconomic theory. Friedman argued that the velocity of money is highly predictable and that the demand for money function is highly stable and insensitive to interest rates. This implies that the quantity of money demanded can be predicted accurately by the money demand function.

2.1. Money demand in Africa

Whether money demand is stable is an empirical question that provides important insight for theory and policy making.[4] Empirical studies of money demand in African countries include Teriba (1974), Darrat (1986), Arize, Darrat, and Meyer (1990), Adam (1992), Kallon (1992), Simmons (1992), Fielding (1994), Ghartey (1998), Nachega (2001), Anoruo (2002), Nwaobi (2002), Nell (2003), Sterken (2004), Akinlo (2005), Nwafor, Nwakanma, Nkansah, and Thompson (2007), Owoye and Onafowora (2007), Bahmani-Oskooee and Gelan (2009), Chukwu, Agu, and Onah (2010) and Drama and Yao (2010). For convenience the major findings of single country empirical investigations are tabulated in Table 1.

[3] Friedman's theory of money demand is a reformulation of the classical quantity theory of money because it leads to the quantity theory conclusion that money is the primary determinant of aggregate nominal spending.

[4] For broader literature on money demand, see for example Leahey and Robins (1985), Swamy and Tavlas (1989), Davidson and Ireland (1990), Boughton and Tavlas (1990), Lothian et al. (1990), Scadding (1990), Caramazza et al. (1990), Cuthbertson and Taylor (1990), Ahumada (1992), Johansen (1992), Bårdsen (1992), Angeloni et al. (1994), Mizen (1996), Engsted and Haldrup (1997), Apergis (1997), Nagayasu (2003), Ramachandran (2004), Belke and Polleit (2006) and Biscarri et al. (2010).

Table 1
Summary of studies on money demand in African economies.

Country	Author	Period; Monetary aggregates	Estimation technique	Income elasticity	Interest rate elasticity	Other findings
Cameroon	Nachega (2001)	1964–1994; *M2*	JML	0.700(2.00)*	0.900(1.30)	*M2* demand is stable.
Côte d'Ivoire	Drama and Yao (2010)	1980–2007; *M1*	JML	5.312(6.16)*	−0.191(0.243)	*M2* demand is *not* stable.
Ghana	Kallon (1992)	1996Q1–1986Q4; *M1*	TSLS	0.667(2.03)*	−0.005(4.53)*	No significant effect of foreign interest rates on *M1* demand.
Kenya	Darrat (1986)	1969Q1–1978Q4; *M1*	OLS	1.843(8.91)*	−0.169(3.40)*	*M1* demand is stable.
Nigeria	Fielding (1994)	1976Q1–1989Q2; *M2*	JML	0.720	1.180	The income elasticity of *M2* for Cameroon and Ivory Coast is 1.50 and 1.58, respectively.
Nigeria	Anoruo (2002)	1986Q2–2000Q1; *M1*	JML	5.700(8.56)*	−5.440(7.92)*	*M1* demand is stable.
Nigeria	Nwaobi (2002)	1960 to 1995; *M1*	VAR	0.639(4.33)*	−0.098(0.889)	Income variable best captures the impact of wealth on *M1* demand.
Nigeria	Akinlo (2005)	1970Q1–2004Q4; *M2*	ARDL	1.094(43.8)*	−0.097(1.91)**	*M2* demand is stable.
Nigeria	Owoye and Onafowora (2007)	1986Q1–2001Q4; *M2*	JML	2.067(5.33)*	0.306(8.191)*	*M2* demand is stable.
Nigeria	Nwafor et al. (2007)	1986Q3–2005Q4; *M2*	VAR	5.430(1.64)**	0.480(0.78)	*M2* demand is stable.
South Africa	Nell (2003)	1965–1997; *M1*, *M2* and *M3*	EG	1.480(13.93)*	+0.940(49.05)*	*M3* demand is stable. However, *M1* and *M2* exhibits parameter instability.

Notes: The *t*-statistics are in parenthesis. OLS, ARDL, VAR, JML, TSLS indicates Ordinary Least Squares, Auto Regressive Distributed Lag, Vector Autoregression, Johansen Maximum Likelihood and Two-Stage Least Squares respectively. Fielding (1994) did not report the standard errors or *t*-statistics. Note for Nell that the value in the interest rate elasticity column corresponds to the price elasticity.

* Significance at 5% level.

** Significance at 10% level.

Adam (1992) established a series of single equation demand for money functions (*M0*, *M1*, *M2* and *M3*) for the Kenyan economy. Application of the Johansen technique suggested that income elasticities of money demand were around unity for *M0* and slightly lower at around 0.8 for the other monetary aggregates; hence, he found that the demand for *M1* is stable. With the exception of Drama and Yao (2010) and Nell (2003), all of these studies conclude that narrow and broad monetary aggregates have been stable in respective African countries and hence support the perspective favouring monetary targeting by central banks.[5]

Many developing countries have underdeveloped, undiversified financial markets that lack financial sector instruments and payment technologies such that the majority of transactions involve the use of narrow money. Therefore one should expect *a priori* that the income elasticity of money demand should be around, or slightly above, unity. However, some studies of African economies, attained implausibly high or low income elasticity estimates, as shown in Table 1, thereby indicating potential inconsistencies.

Implausible estimates can be a result of omitted variable bias. Fielding (1994) extended the classical money demand function to include terms that reflect the variability of real rates of return. Specifically, he applied the Johansen Maximum Likelihood (JML) technique to quarterly data for Cameroon, Ivory Coast, Nigeria and Kenya in order to estimate demand for *M2* and obtained income elasticity estimates of 1.5, 1.58 and 0.72, respectively, for the first three countries. For Kenya, three cointegrating vectors were obtained with a statistically insignificant income elasticity estimate. The degree of heterogeneity in Fielding's income elasticity estimates suggests that it would be difficult to formulate an holistic efficient monetary policy; thus, monetary policy in developing countries may need to be applied on an individual and case-by-case basis.

2.2. The Nigerian case

Nigeria went through a turbulent 1980s which included an instituted period (1986–1988) of the IMF's Structural Adjustment Program (SAP), and it can be argued that the SAP could generate extreme and unusual estimates of the elasticity of money demand. Anoruo (2002) tested for the stability of the demand for *M2* around the SAP period and did find an unreasonably high estimate of 5.70 for the elasticity of demand with respect to industrial production; his other results suggest that the *M2* money demand function was stable during this period and that the money supply is a viable monetary policy tool. A similar study conducted by Owoye and Onafowora (2007) applied the JML technique to *M2* quarterly data and also obtained an implausible income elasticity of 2.1, which again suggests that *M2* demand is stable in Nigeria.[6]

Controversy remains in the literature around the estimates of income elasticities of money demand for Nigeria; above unity estimates have been provided by Akinlo (2005; for *M2* and *M3*) and below unity estimates by Nwaobi (2002; for *M1* and *M2*). Similarly, Owoye and Onafowora (2007) attained a value of 2 while Anoruo (2002) and Nwafor et al. (2007) obtained values of around 6 and 5, respectively. These unexpected and unusual findings invite two obvious questions:

[5] Ghartey (1998) and Kallon (1992) find stable money demand function for Ghana. Simmons (1992) found that the domestic interest rate played a significant role in explaining the demand for M1 in the long run for Côte d'Ivoire, Mauritius and Morocco. Sterken (2004) identified an income elasticity that exceeded unity and some evidence of instability in M1 demand during for Ethiopia.

[6] Implausibly high income elasticities (around 5) have been identified for *M2* and *M1* for Nigeria and Côte d'Ivoire respectively by Nwafor et al. (2007) and Drama and Yao (2010).

first, are these income elasticities reasonable? Second, what contributions do these studies make to the Nigerian money demand literature?

It is logical to expect that income elasticity estimates for advanced OECD countries to be much lower than unity (Baba, Hendry, & Starr, 1992; Ball, 2001) and this is consistent with the Baumol (1952) and Tobin (1956) model. However, for developing countries the income elasticity of money demand is expected to be much higher at around unity or slightly above unity (Rao & Kumar, 2009a, 2009b; Sriram, 1999) and this is more in line with the quantity theory of money (Friedman, 1956). If there is any consensus in the literature then there appears to be support for monetary targeting by the central bank because one or more monetary aggregate measure is found to be stable. Bahmani-Oskooee and Gelan (2009) appear to corroborate this perspective when they tested for the stability of *M2* money demand for 21 African countries (including Nigeria) and obtained a long run relationship between *M2*, the inflation rate, income and the nominal effective exchange rate for all countries.

However, one drawback of all of these empirical studies is that they failed to consider the possibility of structural change in the cointegrating vector. To address structural changes in money demand relationship, Chukwu et al. (2010) did utilize Gregory and Hansen tests, but their study explored only a broader category of money (*M2*). Given that the CBN can easily control narrow money and the fact that it is widely used in Nigeria, it would be prudent to allow and explicitly estimate for the presence of structural change that could have influenced the narrow demand for money relationship. To fill this gap, our paper presents applications of Gregory and Hansen's method to test for structural breaks in the *M1* demand relationship for Nigeria.

3. Data, specification and method

The empirical work outlined below utilizes annual data for real money, real income, nominal rate of interest, real exchange rate and inflation rate over the period 1960–2008 for Nigeria. This sample period is constrained by the availability of data which is sourced from the International Financial Statistics and the World Development Indicators.

We examine *M1* rather than broader aggregates because the Nigerian economy is underdeveloped with moderately high use of narrow money (notes and coins) relative to broader measures (such as debit cards, credit cards and deposits). The NCB should be more able to manage *M1* than broader aggregates because it has direct control over narrow aggregates. Further, with the exception of Nwaobi (2002), no other empirical study has investigated the stability of *M1* demand for Nigeria as existing studies on Nigeria have examined only the demand for broader monetary aggregates. In light of these observations, this paper fills a major gap in the literature.

We first examine the time series properties of these variables using the Augmented Dicky-Fuller (ADF) and Elliot-Rothenberg-Stock (ERS) tests. The results of the ADF and ERS unit root tests are presented in Table 2.

The null hypotheses of non-stationarity of each variable are tested against the alternative hypotheses of stationarity. ADF test results indicate that the unit root nulls for the level variables cannot be rejected at the 5% level (except for the inflation rate) and that the nulls that their first differences have unit roots are rejected. Similarly, the computed ERS test statistics are more than the 5% critical values, implying that all the levels of the variables are non-stationary. However, the test statistics are lower than critical values for the first differences of these variables and reject the unit root null at the 5% level. As the inflation rate is a non-stationary series in the ERS test, and because the ERS test is stronger than the ADF test, we argue that the level variables are non-stationary and that their first differences are stationary.

Table 2
ADF and ERS unit root tests, 1960–2008.

Variable	LAG	ADF	ERS
$\ln m$	[1,0]	−1.482 (3.56)	8.112 (3.66)
$\Delta \ln m$	[0,1]	−5.734 (3.57)	6.042 (7.23)
$\ln y$	[2,1]	−2.008 (3.56)	13.025 (2.85)
$\Delta \ln y$	[0,1]	−10.134 (3.57)	2.372 (12.87)
R	[1,1]	−0.725 (3.56)	14.927 (6.68)
ΔR	[0,1]	−3.672 (3.57)	7.051 (13.47)
$\ln E$	[1,1]	−1.074 (3.56)	10.825 (2.85)
$\Delta \ln E$	[0,1]	−7.672 (3.57)	6.597 (12.87)
π	[1,2]	−4.230 (3.56)	13.927 (6.68)
$\Delta \pi$	[0,1]	−5.185 (3.57)	7.074 (13.47)

Notes: LAG is the lag length of the first differences of the variables. For example [1,1] means that one lagged first difference is found to be adequate in the two test statistics, respectively. For both ADF and ERS, the absolute value 5% critical values are given below the test statistics in parentheses. A time trend is included because it is significant in levels and first differences of the variables. ADF and ERS tests were conducted in Microfit 4.1 and E-views, respectively.

Many empirical studies have estimated canonical specifications for the demand for money; however, it may be necessary to control for the true cost of holding money and so we specify the demand for money in its canonical form and its extended versions, such that:

$$\ln m_t = \theta_0 + \theta_y \ln (y_t) + \theta_R R_t + \varepsilon_t \tag{1}$$

$$\ln m_t = \theta_0 + \theta_y \ln (y_t) + \theta_R R_t + \theta_E \ln E_t + \varepsilon_t \tag{2}$$

$$\ln m_t = \theta_0 + \theta_y \ln (y_t) + \theta_R R_t + \theta_E \ln E_t + \theta_\pi \pi_t + \varepsilon_t \tag{3}$$

where θ_0 is the intercept, m is the real narrow money stock, y is the real output, R is the cost of holding money proxied with the nominal short-term interest rate, E is the cost of holding money proxied with the real effective exchange rate, π is the cost of holding money proxied with the inflation rate and $\varepsilon \approx N(0,\sigma)$. Real money balances are defined as the narrow monetary aggregate, *M1*, deflated by the GDP deflator. Real output is constructed using nominal GDP deflated by GDP deflator and the 3-month deposit rate is our proxy for the nominal interest rate. Inflation rate is computed as the change in the GDP deflator.

The Gregory and Hansen (1996a) and Gregory and Hansen (1996b) (henceforth GH) technique permits the estimation of cointegrating vectors while simultaneously allowing for a break date.[7] This gives the technique important advantages over others[8] if the purpose is to examine the change in slope parameters that are due to the impact of structural breaks, and the null hypothesis of no cointegration with structural breaks is tested against the alternative of cointegration. Four models are proposed by GH that are based on alternative assumptions about structural breaks: (i) level shift; (ii) level shift with trend; (iii) regime shift where both the intercept and the slope coefficients change and (iv) regime shift where intercept, trend and slope coefficients change. Although this technique does not offer multiple break dates, the single break date is endogenously determined. We apply Eq. (3) to these four approaches, such that:

[7] Bai and Perron (1998, 2003) tests are widely used but are specifically designed to determine breaks in the context of unit roots. Analogous to GH test are Carrion-i-Silvestre and Sanso (2006) and Arai and Kurozumi (2007) tests.

[8] Others here refer to conventional methods such as the EG, VAR, JML and ARDL, among others.

GH-1: level shift

$$\ln m_t = \mu_1 + \mu_2\varphi_{tk} + \alpha_1 \ln(y_t) + \alpha_2 R_t + \alpha_3 \ln E_t + \alpha_4\pi_t + \varepsilon_t \quad (4)$$

GH-2: level shift (includes trend)

$$\ln m_t = \mu_1 + \mu_2\varphi_{tk} + \beta_1 t + \alpha_1 \ln(y_t) + \alpha_2 R_t + \alpha_3 \ln E_t + \alpha_4\pi_t + \varepsilon_t \quad (5)$$

GH-3: regime shift (intercept and slope coefficients change)

$$\ln m_t = \mu_1 + \mu_2\varphi_{tk} + \beta_1 t + \alpha_1 \ln(y_t) + \alpha_{11} \ln(y_t)\varphi_{tk} + \alpha_2 R_t + \alpha_{22} R_t\varphi_{tk} + \alpha_3 \ln E_t + \alpha_{33} \ln E_t\varphi_{tk} + \alpha_4\pi_t + \alpha_{44}\pi_t\varphi_{tk} + \varepsilon_t \quad (6)$$

GH-4: regime shift (intercept, trend and slope coefficients change)

$$\ln m_t = \mu_1 + \mu_2\varphi_{tk} + \beta_1 t + \beta_2 t\varphi_{tk} + \alpha_1 \ln(y_t) + \alpha_{11} \ln(y_t)\varphi_{tk} + \alpha_2 R_t + \alpha_{22} R_t\varphi_{tk} + \alpha_3 \ln E_t + \alpha_{33} \ln E_t\varphi_{tk} + \alpha_4\pi_t + \alpha_{44}\pi_t\varphi_{tk} + \varepsilon_t \quad (7)$$

where φ is the shift in the slope, intercept or trend coefficient. The break date is attained by estimating the cointegration equations for all possible break dates and a break date is selected where the absolute value of the ADF test statistic is at its maximum.[9]

4. Empirical results

4.1. Break tests

Application of the GH cointegration technique to Nigerian money demand data for the period 1960–2008 reveals the results provided in Table 3. The null hypothesis of no cointegration is rejected for canonical specification (1) in models 1, 2 and 4, and the endogenously determined break dates are 1992 in model 1 and 1986 otherwise. For specifications (2) and (3), GH models 1 and 3 reject the null hypothesis of no cointegration and again offer the break date of 1986. These results imply that there exists a long run relationship between real money, real income, nominal rate of interest, real exchange rate and the inflation rate in Nigeria.

The break dates are sensible. The Nigerian economy did introduce financial sector reforms in the mid-1980s. In particular, the 1986 reforms coincided with the instigation of the IMF's SAP and the introduction of e-money in Nigeria's banking lexicon. Prior to 1986, Nigeria had only 40 banks, but the number increased progressively thereafter to reach 120 in 1992. Between 1986 and 1993, the CBN made efforts to create a new environment for the introduction of an indirect approach to monetary management.[10]

[9] Note that the critical values for cointegration in this procedure are different. GH has tabulated the critical values for testing cointegration in the Engle-Granger (EG) method with unknown breaks. The well known EG method is a single equation time series technique and at first, the level variables are estimated to obtain long run elasticities. In the second stage the short run dynamic EG model is estimated. This technique also uses MacKinnon's (1991) procedure to confirm cointegration between variables. Note that GH developed the critical values by modifying the MacKinnon (1991) procedure.

[10] Further details on financial reforms in Nigeria could be obtained from the official website of the Central Bank of Nigeria. http://www.cenbank.org/monetaryPolicy/Reforms.asp.

Table 3
Cointegration tests with structural breaks, 1960–2008.

GH model	Specification			
	Break date	GH test statistic	5% critical value	Existence of cointegration
$\ln m_t = \theta_0 + \theta y \ln(y_t) + \theta_R R_t + \varepsilon_t$ (1)				
GH-1	1992	−4.187	−3.603	Yes
GH-2	1986	−5.775	−3.603	Yes
GH-3	1993	−0.159	−3.190	No
GH-4	1986	−3.892	−3.190	Yes
$\ln m_t = \theta_0 + \theta_y \ln(y_t) + \theta_R R_t + \theta_E \ln E_t + \varepsilon_t$ (2)				
GH-1	1986	−6.371	−3.603	Yes
GH-2	2002	−0.763	−3.603	No
GH-3	1986	−2.376	−3.190	No
GH-4	1992	−2.007	−3.190	No
$\ln m_t = \theta_0 + \theta_y \ln(y_t) + \theta_R R_t + \theta_E \ln E_t + \theta_\pi \pi_t + \varepsilon_t$ (3)				
GH-1	1992	−1.095	−3.603	No
GH-2	1994	−3.106	−3.603	No
GH-3	1986	−7.734	−3.190	Yes
GH-4	1986	−1.989	−3.190	No

4.2. Cointegrating equations

In the second stage we use the Engle–Granger technique to estimate the cointegrating equations for the models in which cointegration exists to enable us to select the optimal model. These results are reported in Table 4.

The estimates of the canonical specification (1) imply that GH-4 is the most plausible model given that all the coefficients are statistically significant with the expected signs and magnitudes. The income elasticity of demand for money estimate is around 0.9 and the Wald test could not reject at the 5% level that this estimate is unity.[11]

In specification (2) the GH model produces the incorrect sign for the income elasticity estimate while the exchange rate variable is insignificant at conventional levels. Specification (3) does support the perspective that the inflation rate seems to capture the cost of holding money, however, both the income elasticity and the inflation rate estimate are only weakly statistically significant. Thus we shall disregard the estimates of specifications (2) and (3) because they appear potentially unreliable. To this end, we favour the canonical specification (1) and argue that the money demand function in Nigeria has undergone some regime shifts that led to changes in the intercept, trend and slope coefficients.

Our income elasticity for money demand estimate is slightly lower than that obtained by Akinlo (2005). One possible source of this difference is that the regime shifts may have contributed to some increased scale economies in the demand for money; nevertheless, it is worth examining whether the money demand function has become unstable. To test the stability of the Nigerian money demand function we use the residuals from GH-4 of the canonical specification to estimate the short run dynamic equation for the demand for money with the error-correction adjustment model (ECM).

[11] The Wald test computed χ^2 (1) test statistic is 0.040 ($p = 0.841$) and statistically insignificant.

Table 4
Cointegrating equations 1960–2008.

	Specification (1)			Specification (2)	Specification (3)
	GH-1 (1992)	GH-2 (1986)	GH-4 (1986)	GH-1 (1986)	GH-3 (1986)
Intercept	1.067 (2.35)*	3.461 (8.94)*	1.148 (3.45)*	2.065 (2.03)*	1.074 (7.94)*
Dum × intercept	−0.568 (1.78)**	−1.250 (1.86)**	−1.355 (4.72)*	−1.246 (0.76)	−1.663 (6.56)*
Trend	–	0.007 (1.69)**	0.167 (2.01)*	–	0.025 (3.40)*
Dum × trend	–	–	−0.659 (3.11)*	–	–
$\ln(y_t)$	1.634 (1.20)	2.350 (0.53)	0.904 (4.52)*	−0.076 (1.13)	1.241 (1.76)**
Dum × $\ln(y_t)$	–	–	0.918 (5.62)*	–	1.309 (1.60)
R_t	−0.071 (2.35)*	−1.054 (1.70)**	−0.021 (1.98)*	−0.179 (1.80)**	−0.213 (0.64)
Dum × R_t	–	–	−0.019 (3.16)*	–	−0.196 (1.04)
$\ln E_t$	–	–	–	−0.566 (1.54)	−1.763 (1.50)
Dum × $\ln E_t$	–	–	–	–	−0.785 (0.88)
π_t	–	–	–	–	−0.127 (1.84)**
Dum × π_t	–	–	–	–	−0.094 (1.05)

Notes: Absolute *t*-ratios are in parentheses below the coefficients. The year relevant for the dummy variable is indicated in the column header in parentheses. For example, DUM1992 means that the dummy is unity after that year and so on.
* Significance at 5% level.
** Significance at 10% level.

In developing the short run ECM model, we adopted Hendry's econometric methodology known as the General to Specific (GETS) technique[12] and regressed $\Delta\ln(m_t)$ on its lagged values, the current and lagged values of $\Delta\ln(y_t)$ and ΔR_t, and the one period lagged residuals from the cointegrating equation of GH-4. A maximum of 4 period lags is chosen given that the sample is comprised of 48 annual observations for each variable. Further application of variable deletion tests attains the following parsimonious equation[13]:

$$\Delta\ln m_t = \underset{(5.64)*}{2.078} - \underset{(4.72)*}{0.386}\,\mathrm{ECM}_{t-1} + \underset{(2.34)*}{1.876}\,\Delta\ln(y_{t-1}) + \underset{(2.01)*}{0.449}\,\Delta\ln(y_{t-3}) - \underset{(3.60)*}{0.115}\,\Delta\mathrm{R}_{t-3} + \underset{(1.99)*}{0.207}\,\Delta\ln M_{t-2} \quad (8)$$
$$R^2 = 0.709, \quad \mathrm{SER} = 0.041, \quad \text{Period}: 1965 - 2008$$

$$\chi^2_{sc} = 0.056\,(0.81), \quad \chi^2_{ff} = 0.384\,(0.54), \quad \chi^2_{n} = 0.569\,(0.75), \quad \chi^2_{hs} = 2.209\,(0.14)$$

All the estimated coefficients are statistically significant at the 5% level. The lagged error correction term (ECM_{t-1}) has the expected negative sign; this implies a negative feedback mechanism which suggests that if there are departures from equilibrium in the previous period, this departure is reduced by about 39% in the current period. The χ^2 statistics indicate that there are no econometric specification problems associated with serial correlation (χ^2_{sc}), functional form misspecification (χ^2_{ff}), non-normality (χ^2_{n}) or heteroskedasticity (χ^2_{hs}) in the residuals; hence, the results presented for Eq. (8) are well-determined and robust. Having obtained the short run dynamic model it is prudent to proceed and test for the stability of the money demand function; when Eq. (8) is subjected to *TIMVAR* stability tests neither the *CUSUM* nor the *CUSUM SQUARES* indicate instability issues, as shown in Figs. 1 and 2. Our results show that there was been a regime shift in 1986, which did increase the scale economies of *M1* demand but did not led to any instability. In other words, the canonical equation underwent a regime shift but was largely

[12] For an overview and strengths of the GETS technique, see Rao et al. (2010).
[13] The absolute *t*-ratios are in the parentheses below the coefficients and * denotes significance at the 5% level.

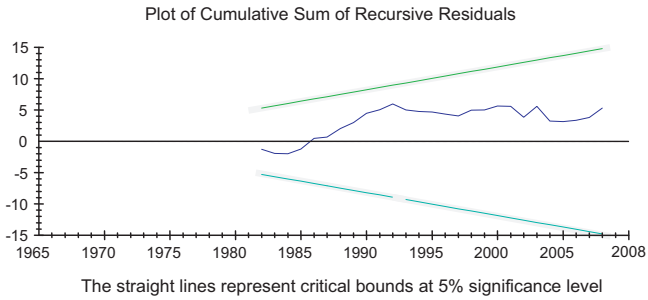

Fig. 1. *CUSUM* test for Eq. (8).

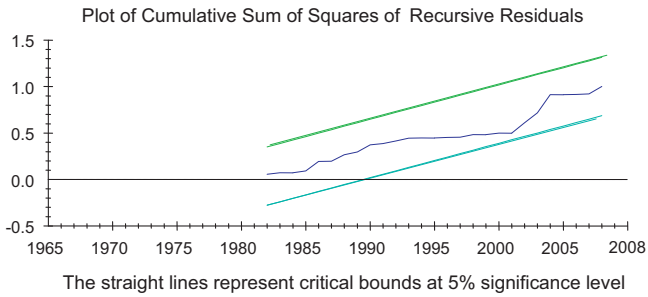

Fig. 2. *CUSUM SQUARES* test for Eq. (8).

stable. Further, we argue that stability tests would be biased due to short sample if *M1* demand stability is tested for the pre- and post-break sample periods.

There is evidence to support the view that there was some improvement in the economies of scale with respect to the demand for money around 1986 because our findings reveal an important regime shift in the money demand relationship. However, even if we allow for structural breaks in the cointegrating relationship, the demand for money function largely remains stable for this economy.

These tests imply that the money demand function is temporally stable in Nigeria and therefore the appropriate monetary policy for the CBN to adjust is the money supply. However, if the CBN chooses to follow the advanced countries example and target the rate of interest then this policy could cause greater instability in income levels. Our policy recommendations are consistent with Poole (1970).

5. Conclusion

Knowledge of the stability and level of money demand is vital if appropriate and correct monetary policy is to be implemented. According to Poole (1970), interest rates should only be targeted when the demand for money functions are unstable. During the 1980s and 1990s, monetary targeting was the dominant monetary policy framework in Nigeria. However, in 2006 the Central Bank of Nigeria (CBN) adopted the new monetary policy framework through which short-term interest rates are adjusted to achieve stability in the value of the domestic currency. The intermediate instruments of monetary policy still include the open market operations and reserve

requirements. The question of interest is: Should Nigeria use the rate of interest as the primary instrument of monetary policy?

This paper has presented an empirical investigation into the demand for Nigerian real narrow money (*M1*) over the period 1960–2008 in an attempt to identify whether the CBN were right to adopt the new monetary policy framework. Two specifications were investigated: the canonical form and its extended forms through augmentations of real exchange and inflation rates to capture the costs of holding money. In all cases, we find that the canonical specification of the money demand performs better for the Nigerian economy.

The results suggest that there is a cointegrating relationship between real narrow money, real income and the nominal rate of interest after allowing for a structural break. Out of a range of four possible models, the model including the regime shift (intercept, slope coefficients and trend changes) corresponding to 1986 yields the preferred model. Our findings imply that the demand for money was stable in Nigeria between 1960 and 2008 although there is evidence to suggest that it may have declined by a small amount around 1986. The estimated income elasticity of money demand is around unity while the interest rate elasticity is negative and significant.

We find no evidence that the money demand function for Nigeria has become unstable due to financial sector liberalization and reforms. The IMF Structural Adjustment Program (1986) appears to have increased the scale economies of *M1* demand but there is no evidence of any *M1* demand instability. Hence, and following Poole's (1970) analysis, we conclude that the money supply is the appropriate monetary policy instrument to be targeted by the CBN and failure to utilize the money supply as an instrument of monetary policy may result in fluctuations in the level of output. These findings imply that Nigeria could effectively use the supply of money as an instrument of monetary policy, which strongly contradicts Nigeria's use of a new monetary policy framework.

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